DOCUMENT RESUME

ED 102 938 IR 001 608

AUTHOR	Spence, Michael; Owen, Bruce
TITLE	Television Programming, Monopolistic Competition and Welfare. Technical Report No. 159.
INSTITUTION	Stanford Univ., Calif. Inst. for Mathematical Studies in Social Science.
SPONS AGENCY	National Science Foundation, Washington, D.C.
REPORT NO	SU-IMSSS-TR-159
PUB DATE	Jan 75
NOTE	52p.
EDRS PRICE	MF-$0.76 HC-$3.32 PLUS POSTAGE
DESCRIPTORS	Audiences; *Broadcast Industry; Cable Television; Commercial Television; Costs; Economic Factors; *Economic Research; Mass Media; Media Selection; *Programing (Broadcast); *Television; Television Viewing; *Welfare
IDENTIFIERS	FCC; Federal Communications Commission; Pay Television

ABSTRACT

An economic analysis of television programing was conducted focusing on the public welfare implications of alternative market structures and policies in the broadcasting industry. Welfare was measured by the sum of producer's and consumer's surplus. It was demonstrated that any of the private market systems considered contain biases against certain kinds of programs. Bias was present with pay TV, but it was worse under a competitive, advertiser supported structure. The study results suggested that pay TV on cable, with its elastic supply of channels, offers the opportunity for more programs than can be supported by advertising, and that this has a desirable effect on viewer welfare. (Author/PF)

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TELEVISION PROGRAMMING, MONOPOLISTIC COMPETITION AND WELFARE

by

Michael Spence and Bruce Owen

Technical Report No. 159
January 1975

Prepared Under
NATIONAL SCIENCE FOUNDATION GRANTS GS-39004 and GS-40104

THE ECONOMICS SERIES
INSTITUTE FOR MATHEMATICAL STUDIES IN THE SOCIAL SCIENCES
Fourth Floor, Encina Hall
Stanford University
Stanford, California
94305

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TELEVISION PROGRAMMING, MONOPOLISTIC COMPETITION AND WELFARE*

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Michael Spence and Bruce Owen

1. Introduction

Television program markets are of considerable importance to the economy: according to Mr. Nielsen's survey statistics, the average adult spends about six hours a day watching television. Other studies talk of reservation prices for existing bundles of programs on the order of forty dollars per household per month, or thirty billion dollars a year for all households. An examination of the welfare implications of alternative policies in this highly regulated market might therefore be quite productive.

Advertiser supported television (and radio) has always posed a challenge to economic analysis. Various economists have examined distortions in program selection that result from advertiser support. These analyses have generally resembled models of spatial competition, and much of their flavor can be traced to Hotelling's famous paper on location. But none of the papers has employed a defensible measure of welfare.[1/] In most, the intensity of people's preferences are not fully taken into account.

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*This work was supported by National Science Foundation Grants GS-39004 and GS-40104 and by the Hoover Institution. The authors are grateful to Ron Braeutigam and to Walter Heller and members of the Department of Economics at the University of California at San Diego for helpful comments on an early draft.

There are several phenomena that make broadcasting a peculiar market. First, consumers are given a free product (the program) in order to generate audiences which are then sold to advertisers. The program is free to the consumer not only because the transactions costs of collecting for programs are high, but also because the Federal Communications Commission (FCC) forbids per program charges for most programs. Second, TV programs have some of the attributes of public goods; the marginal cost of an additional viewer is almost literally zero. (Of course it may be necessary to spend more on program production to induce a larger audience to view the program.) Third, there is alleged to be an artificial scarcity of channels, due to FCC regulatory decisions.[2/]

These three conditions have been used to explain deficiencies in television performance, particularly with respect to the number and types of programs that are offered. Most economists would probably agree with the argument that FCC rules limiting the number of channels are inefficient. A few might also agree that rules barring pay TV (that is, TV that charges on a per program basis) might also be a cause of inefficiency. There is a policy debate on these matters. The issues are these. Should cable television systems be allowed to charge on a per program basis?[3/] Should control over channels on cable television be in the hands of one firm (the operator) or leased out to competitive programmers on a common carrier basis? It is the purpose of this paper to try to shed some light on these and other policy issues from the point of view of welfare economics by considering the forces that influence program selection under different supply conditions.

There are four pure cases of interest: advertiser support, or direct viewer payment (pay TV), with either limited or unlimited channels. (For our purposes, cable television is identical to over-the-air television, except that channel capacity on cable is not limited.) We wish to compare economic welfare in each of these four cases with each other and with the optimum. In addition, we shall examine the welfare implications of the choice between monopoly and competition, because some authors have argued that, at least under advertising support, monopoly may perform more efficiently than competition.[4/]

In most of what follows, we are comparing second best outcomes. This requires a measure of welfare. We use the total surplus: the gross dollar benefits of a collection of programs, minus the cost of supplying the programs. It is the multi-market sum of consumer and producers' surpluses. It is unambiguously defined only when income effects are negligible, and for the present analysis, income effects are assumed away.[5/]

The choice between pay TV and advertiser-supported TV is a choice between second best outcomes. Under any system, the marginal cost of supplying the program to an additional viewer is virtually zero. An efficient per program charge is therefore zero. Under advertiser support, the per program charge to the viewer is zero: pricing is efficient. However, the program is not supplied unless revenues cover the cost of producing the program, a cost that is independent of the number of viewers. The revenue under advertiser support comes from advertisers who pay a

price of roughly two cents per viewer per hour of prime time. The issue with respect to program selection then is whether two cents is a reasonable estimate of the average value of the program to the viewers of it. If it is not, then revenues may understate the social value of the program, and some programs with a potential positive surplus may not be profitable.

Under pay TV, producers of programs can appropriate a larger fraction of the surplus generated by a program by pricing it above marginal cost. Provided programs are not perfect substitutes for each other, pay TV will have the character of monopolistic competition. There will be an efficiency loss due to non-marginal cost pricing. However, by appropriating part of the surplus, the producers of some programs may be able to make positive profits when they could not with advertising support. Therefore, the attraction of pay TV is its potential for generating programs that cater to the tastes of groups of viewers whose size is sufficiently small that the program would be unprofitable under advertiser support. Pay TV has the ability partially to take into account the intensity of preferences. Thus the basic tradeoff is between inefficient pricing on the one hand, and the failure of advertiser supported TV to respond to intensities of preference on the other.

Even under pay TV (and in monopolistic competition more generally), there are potential problems with program selection. These result from the fact that revenues are only a fraction of the benefits generated by a program. Thus programs that yield a positive contribution to total surplus

may still be unprofitable becuase the revenues fail to cover fixed costs. But more importantly, the relationship between revenues and contributions to surplus will vary over programs, according to their demand characteristics. And therefore the market will be biased against certain kinds of programs in ways that are discussed below.

The analysis to follow deals with two related questions. The first is what biases in program selection arise under pay TV and under advertiser supported TV? Biases are to be interpreted as departures from the optimum. The biases are stated in terms of the demand and cost characteristics of programs. We argue that pay TV is biased against programs with low price elasticities of demand, and against high cost programs, and that advertiser supported TV is also, but more strongly. The second issue concerns the numbers of programs and the sizes of their audiences. Leaving aside biases and focusing on collections of similar programs, one can ask whether either regime supplies too many or too few programs.

The study of program selection under pay TV is formally indistinguishable from the analysis of product selection under monopolistic competition.[6/] Some of the following models could be stated in more general ways at great cost in terms of notational complexity. We feel they illustrate the important forces better than would a more abstract analysis.

Policy choices in this market are dependent on the structure of demand, and that is an empirical question. Our aim here is not to dispose of the policy issues (and we certainly have not). It is rather,

in the context of an explicit welfare criterion, to focus attention upon important parameters that determine the welfare implications of regulatory policies. These parameters are objects about which one can have intuitions as well as evidence, and upon which the policy debate can be based.

2. Sources of Bias in Program Selection

The Model

We begin by supposing that there are n possible different types of programs. The list can be rather long and is intended to be exhaustive. The number of viewers of the i-th program (the audience size) is x_i, $i = 1,\ldots,n$. The vector x is $(x_1,\ldots,x_n)$. Given a set of program offerings, each viewer will select his preferred program. Each viewer has a reservation price for the program he selects, a number that gives the dollar value of that program to him. We add up these dollar benefits for all viewers to arrive at a measure of the gross dollar benefits for all viewers. These are denoted $B(x)$, the benefit function.

To illustrate biases in program selection, we shall use a benefit function with the following form:

$$(1) \qquad B(x) = \sum_i \phi_i(x_i) - \sum_{i,j} A_{ij} x_i x_j \quad .$$

Each $\phi_i(x_i)$ is concave. (That is equivalent to assuming demand curves are downward sloping. See below.) Without loss of generality, $A_{ii} = 0$ for all i. The coefficients A_{ij} are non-negative so that $B_{ij} = -2A_{ij} < 0$ and all programs are substitutes.

This functional form gives us considerable flexibility in specifying the demand interactions among products. A pair of products i and j can be demand independent ($A_{ij} = 0$) or very close substitutes (A_{ij} large). We can characterize groups of close substitutes or what have been referred to as lowest common denominator programs within this framework. In addition, the functions $\phi_i(x_i)$ determine the shapes of the individual demand functions (see below) and these can be selected in any desired fashion. The form (1) is not perfectly flexible. But it can be generalized without affecting the qualitative conclusions set out below.[7/]

We assume that viewers choose programs in a one-period context (i.e., one hour), so that each viewer consumes only one program. No two programs are perfect substitutes though they can be very close substitutes.

When confronted with prices, $p_1,\ldots,p_n$, for the n programs, viewers will react by allocating themselves to programs so as to maximize the net benefits to them:

$$B(x) - \sum_i p_i x_i \quad . \tag{2}$$

Therefore, maximizing (2) with respect to x, we have

$$\frac{\partial B_i}{\partial x_i} = B_i = p_i \quad , \qquad \text{for } i = 1,\ldots,n \quad . \tag{3}$$

The conditions (3) can be interpreted in another way. Since they hold for any set of prices $p_1,\ldots,p_n$, they define the inverse demand functions

for the programs. The inverse demand functions are the partial derivatives of the benefit function.

Let us turn briefly to advertising and to program costs. Let z be the price per viewer paid by advertisers, and let F_i be the cost of producing a program of type i. For prime time network television, $F_i \approx 250{,}000$ dollars per hour and $z \approx 2$ cents per household for the six minutes of commercials permitted. In practice, z is a declining function of x_i, and there is some relationship between i and z. For example, viewers care about the amount of advertising. We could handle that by making the same programs with different numbers of minutes of advertising, different programs (because demands would be different). But then z_i would depend on the program. In what follows, we ignore these complications, though no important conclusion is affected by the simplification.

Since we are not interested in the advertising market per se, but only in its impact on programming, we shall assume that advertisers pay exactly what advertising is worth to them.[8/] Thus the surplus in the advertising market is equal to the revenues it provides the suppliers of programs.

The surplus generated by both markets is the sum of benefits to consumers, $B(x)$, and the advertising revenues, $z\sum_i x_i$, minus costs of programs, $\sum_i F_i$. Letting $T(x)$ be the total surplus, we have

$$T(x) = B(x) + \sum_i (zx_i - F_i) \quad . \tag{4}$$

Program Selection Under Pay TV

We begin by considering program selection under pay TV with unlimited channels. The price per viewer for the i-th program is $p_i(x) = B_i(x)$. Therefore the profits of the supplier of the i-th program are

$$\pi_i = p_i x_i + z x_i - F_i \tag{5}$$
$$= B_i x_i + z x_i - F_i \quad .$$

Note that advertising is permitted as well as per program fees.

The market is monopolistically competitive. Each firm maximizes profits by setting x_i, and entry occurs until all profitable programs are being supplied.[9/]

We want to characterize the market equilibrium in a way that facilitates comparison with the optimum. We do this by showing that the process of competitive interaction (including entry and exit) results in the implicit maximization of some function which is neither the total surplus, nor industry profits.

When $B(x)$ has the form (1), then the total surplus is

$$T(x) = \sum_i (\phi_i + z x_i - F_i) - \sum_{i,j} A_{ij} x_i x_j \quad . \tag{6}$$

The profits of the i-th firm are

$$\pi_i = x_i \phi_i' + z x_i - F_i - 2 \sum_j A_{ij} x_i x_j \quad . \tag{7}$$

Industry profits are

$$(8) \qquad \pi = \sum_i \pi_i = \sum_i (x_i \phi_i' + z x_i - F_i) - 2 \sum_{i,j} A_{ij} x_i x_j \quad .$$

We shall show that the monopolistically competitive market implicitly maximizes the function

$$(9) \qquad R(x) = \sum_i (x_i \phi_i' + z x_i - F_i) - \sum_{i,j} A_{ij} x_i x_j \quad .$$

The argument is straightforward; we give it and then comment. The argument is that

$$(10) \qquad R(x) - R(x_1, \ldots, x_{i-1}, 0, x_{i+1}, \ldots, x_n) = (x_i \phi_i' + z x_i - F_i) - 2 \sum_j A_{ij} x_i x_j \qquad \text{(from (9))}$$

$$= \pi_i \quad . \qquad \text{(from (7))}$$

Thus $\pi_i(x) = R(x)$ - something that does not depend on x_i. Thus in maximizing π_i with respect to x_i, the i-th program producer is maximizing $R(x)$ with respect to x_i. Thus all producers together act so as to maximize $R(x)$.

By comparing $R(x)$, $T(x)$ and $\pi(x)$, we can determine the ways in which competitive pay TV and monopoly under pay TV will deviate from the optimum both in terms of pricing and program selection. We turn therefore to these differences.

The difference between $T(x)$ and $R(x)$ is that the $\phi_i(x_i)$ in $T(x)$ are replaced by $x_i\phi_i'$ in $R(x)$. These small differences have large consequences. Since ϕ_i is concave (it must be for demand, $\partial p_i/\partial x_i = \phi_i'' < 0$, to be downward sloping), $\phi_i > x_i\phi_i'$. Thus revenues are less than the program's contribution to surplus. For reference, the contribution of program i to the surplus is

$$\Delta T_i = \phi_i + zx_i - F_i - 2\sum_j A_{ij}x_jx_i \quad . \tag{11}$$

This means that ΔT_i can be positive when $\pi_i < 0$ in which case the program will be lost. To simplify notation, let the linear coefficient of x_i in T and R be

$$c_i = 2\sum_j A_{ij}x_j - z \quad . \tag{12}$$

The pattern of pricing is also affected by the difference between ϕ_i and $x_i\phi_i'$. From (11) and (7) we have

$$\frac{\partial \Delta T_i}{\partial x_i} = \phi_i' - c_i \quad , \tag{13}$$

while

$$\frac{\partial R}{\partial x_i} = \frac{\partial \pi_i}{\partial x_i} = \phi_i' + x_i\phi_i'' - c_i \quad . \tag{14}$$

Therefore when $\partial\pi_i/\partial x_i = 0$, $\partial\Delta T_i/\partial x_i > \partial\pi_i/\partial x_i = 0$. This is the familiar tendency of monopolistic competition to price above marginal cost.

We can use this apparatus to analyze the biases in program selection which characterize monopolistic competition and pay TV. To facilitate the exposition, we consider the case in which $\phi_i(x_i) = a_i x_i^{\beta_i}$, where a_i and β_i are parameters and $0 < \beta_i < 1$, so that ϕ_i is concave. Let

$$\Delta T_i^* = \max_{x_i} \Delta T_i \quad , \tag{15}$$

and let

$$\pi_i^* = \max_{x_i} \pi_i \quad . \tag{16}$$

A somewhat tedious calculation yields the conclusion that[10/]

$$(\pi_i^* + F_i) = \beta_i^{\frac{1}{1-\beta_i}} (\Delta T_i^* + F_i) \quad . \tag{17}$$

In words, (17) says the maximized revenues for a program are a fraction $(\beta_i^{1/(1-\beta_i)})$ of the maximized gross benefits of that program. Equation (17) is the crucial relationship for examining biases in product selection.

It is easily verified that the function

$$n(\beta) = \beta^{\frac{1}{1-\beta}} \quad , \tag{18}$$

increases monotonically from 0 to 1/e on the interval $[0,1]$.[11/] Therefore, the smaller β_i is, the smaller will be the ratio of revenues

to incremental benefits. It is now not difficult to see that the bias is against products with small β_i's. Specifically, assume two products i and j have the same program costs, $F_i = F_j = F$, and suppose they contribute equally to the surplus, $\Delta T_i^* = \Delta T_j^*$. Then from (17)

$$\frac{\pi_i^* + F}{\pi_j^* + F} = \frac{n(\beta_i)}{n(\beta_j)} \quad . \tag{19}$$

Thus, if $\beta_i < \beta_j$, $\pi_i^* < \pi_j^*$. If $\pi_j^* = 0$ so that programming is just profitable, program i, which contributes equally to the surplus, will be unprofitable and will not be produced, though its contribution to the surplus is positive. In the present parameterization of the problem, the bias is against products with small β_i's. What is β_i? Since

$$p_i = a_i \beta_i x_i^{\beta_i - 1} - c_i \quad , \tag{20}$$

it is fairly clear that β_i determines the steepness of the inverse demand function. This is akin to but not the same as the own-price elasticity of demand. Therefore the bias is against programs with steep inverse demand functions. These are precisely programs with small groups of high value viewers after which reservation prices fall off rapidly.

Stepping back from the present parameterization, the general bias is against programs that have demands such that revenues capture a small fraction of the gross benefits. This comes as no surprise. When the entry condition is profitability, revenues are the signal of benefits.

They will be a more or less misleading signal depending upon the fraction of the benefits they actually capture. Programs for which revenues are a small fraction of the surplus are special interest programs.

It is important to note that not all programs with small β_i's are eliminated. Some may simply have huge audiences (i.e., a_i is large). That is why the bias is stated in terms of constant or equal contributions to the surplus.

There is another bias; one against costly programs. It is also derivable from equation (17). Suppose that for two programs, i and j, $\Delta T_i^* = \Delta T_j^*$, and $\beta_i = \beta_j = \beta$. It follows from (17) that

$$(\pi_i^* = \pi_j^*) = (1 - \beta^{\frac{1}{1-\beta}})(F_j - F_i) \quad . \tag{21}$$

Therefore, if $F_j > F_i$ then $\pi_j^* < \pi_i^*$. If $\pi_i^* = 0$ then program j will be unprofitable and will not be produced even though its contribution to surplus is the same as that at program i. Thus there is a bias against costly programs, other things equal. There seems no obvious relation between program costs and the usual program categories. Some minority taste programs are expensive, others are not, and the same is true of mass appeal programming, leaving aside the effects of competition for scarce factors.

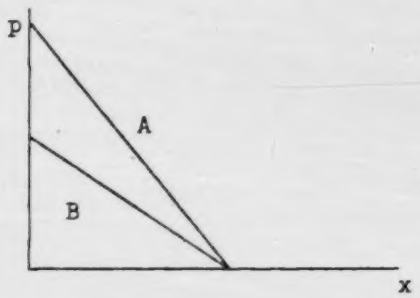
A word about monopoly is perhaps in order. $\pi(x)$ differs from $T(x)$ in two respects: the $\phi_i(x_i)$ are replaced by $x_i\phi_i'$ and the cross effects term is multiplied by two. Two conclusions follow. First,

monopoly will exhibit biases similar to those just described for competition. And second, it will tend to hold prices up more and supply fewer programs than either the optimum or competition. The latter follows from the factor of two multiplying the cross effects term.[12/] Thus monopoly tends to produce less "diversity" and to result in higher prices than monopolistic competition.

Program Selection Under a Competitive, Advertiser Supported System

We examined certain biases in product selection associated with pay TV. We want now to compare these problems with those that arise with an advertiser supported system like the present one. When advertising revenues are the sole source of support, all that matters is what the demand for a program is at a zero price. The products whose demands are depicted in Figure 1 will generate equal revenues with advertiser support, even though both the surplus and profits under pay TV will be larger for product A. Therefore one might expect that advertiser supported TV is even harsher on low elasticity products than pay TV. And with suitable ceteris paribus assumptions, this can be shown to be true.

Figure 1



The point is most easily illustrated with linear demand functions, though the principle applies generally. Assume therefore that $\phi_i(x_i) = a_i x_i - A_{ii} x_i^2$. With this assumption, the demand for the i-th product is

$$p_i = {}_i = (a_i - c_i) - 2A_{ii}x_i \quad , \tag{22}$$

where c_i is as defined in (12). Under advertiser support, prices to viewers are zero so that audience size is

$$x_i = \frac{a_i - c_i}{2A_{ii}} \quad . \tag{23}$$

The profits of the i-th program produced under advertiser support are

$$\hat{\pi}_i = z\left(\frac{a_i - c_i}{2A_{ii}}\right) - F_i \quad . \tag{24}$$

Under pay TV, the profits of program i maximized with respect to x_i are[13/]

$$\pi_i^* = \frac{(a_i - c_i)^2}{8A_{ii}} - F_i \quad . \tag{25}$$

The maximized contribution to the total surplus is

$$\Delta T_i^* = \frac{(a_i - c_i)^2}{4A_{ii}} - F_i \quad . \tag{26}$$

Notice that $(\pi_i^* + F_i)/(\Delta T_i^* + F_i) = 1/2$. With linear demand curves, there are no biases of the elasticity type, under pay TV. However, from (24) and (25), we have

$$(27) \qquad (\pi_i^* + F_i) = \frac{1}{2} A_{ii} \left(\frac{\hat{\pi}_i + F_i}{z}\right)^2 .$$

It is now easy to establish the biases from advertiser-support. Suppose that for two products, i and j, $F_i = F_j = F$ and $\pi_i^* = \pi_j^*$. From (27) it follows that

$$(28) \qquad \frac{\hat{\pi}_i + F}{\hat{\pi}_j + F} = \sqrt{\frac{A_{jj}}{A_{ii}}} .$$

Therefore, if $A_{ii} > A_{jj}$, then $\hat{\pi}_j < \hat{\pi}_i$. If two programs have the same costs and are equally profitable under pay TV, the program with the steeper demand curve is less profitable under advertiser support. Moreover, the same statement holds for products that contribute equally to the total surplus in the linear case, since with the same costs, the ratio of profits to surplus is always 1/2.

In general, advertiser support, by giving all viewers equal weight serves special interests poorly, and less well than pay TV. Under pay TV, those with strong preferences can, to some extent, vote with dollars.[14/] Advertisers, on the other hand, only count heads.

The program types (or, more generally, commodities) against which monopolistic competition is biased can often be provided by organizations

outside the formal market system. There are clubs, societies, and other not-for-profit institutions formed for the purpose, among others, of publishing a newsletter or magazine or academic journal. We have, then, an explanation of the existence of such organizations in the failure of the market system to provide certain goods. However, there is a difficulty. The bias against such goods is greatest in precisely that case where individual valuations of the good vary widely, and thus where clubs may also have considerable difficulty in setting fees. If a uniform price would capture enough of the surplus to cover costs and normal profits, a club would not be needed. Perhaps this explains the proliferation of rates and membership categories which are often found in clubs. It may be easier for potential members to identify each other than for outsiders to do this. Of course, FCC policies prevent this sort of response in television at present, although public broadcasting has some of the attributes of a club.

From the point of view of biases in product selection, pay TV is not ideal, because prices exceed marginal costs, but it appears to be preferable to advertiser support. The choice may be between not having a program at all, and having it available at an inefficient price. Half a loaf may be better than none.

3. Numbers of Programs and Audience Sizes in Equilibrium

Our concern up to this point has been to show there are biases against programs with certain comparative demand characteristics under

both pay TV and advertiser supported television. Roughly speaking, the biases are against special interest and expensive programs, both being more pronounced under advertiser support.

Apart from these biases, there is the question of which system provides the better second best solution. In this section, we consider this and related questions. Having discussed biases, it is convenient to set that issue aside and to conduct the present analysis by considering similar (but not necessarily highly substitutable) products. In part, this is a device for making the analysis of equilibrium tractible. Specifically, let us assume in the previous model that $\phi_i = \phi$, $F_i = F$ and $A_{ij} = A$ for all i and j. Since the demand parameters and costs of programs are similar in all respects, the audience sizes will be the same in equilibrium: $x_i = x$ for all i. The equilibrium and the optimum can therefore be characterized by n, the number of programs and by x, the audience size. (Note that programs are <u>not</u> assumed to be perfect substitutes for each other.)

With these assumptions, the total surplus in equation (4) becomes

$$T(x,n) = n\phi(x) - Ax^2(n^2 - n) - nF + nzx \quad . \tag{29}$$

The function implicitly maximized by monopolistic competition is

$$R(x,n) = nx\phi' = Ax^2(n^2 - n) - nF + nzx \quad . \tag{30}$$

Industry profits, the objective function of the monopolist, are

$$\pi(x,n) = nx\phi' - 2Ax^2(n^2 - n) - nF + nzx \quad . \tag{31}$$

At this point it is most useful to illustrate the optimum and various equilibria diagrammatically. This is done in Figure 2, for a typical case.[15] In general, the pay TV equilibrium (E) is below and to the left of the optimum (O). Monopoly under pay TV (M) is below and to the left of E. There can be exceptions but they are not of great interest. The points S and T are second best optima of a slightly different kind. T, for example, is the point of tangency of an iso-surplus line with the zero profit line ($R_n = 0$). Thus if entry cannot be controlled but prices can (via taxes or direct regulation), T is the highest attainable point. Similarly, S is the second best with monopolistically competitive pricing taken as given. It is achieved by subsidies to producers of programs. It is possible that E could correspond to either S or T, but not to both.[16]

Under a competitive, advertiser supported system, pricing is optimal so that $T_x = 0$. Entry occurs until profits per program, $zx - F$ are zero. Thus $x = F/z$, as shown (point CA). With monopoly and advertiser support, pricing is the same but the introduction of new programs stops before profits are zero, at a point like MA.

The point X is of some interest. At X, pricing is optimal and the total surplus is the same as at E. Thus X gives the number of programs that are required under advertiser support to equal the performance of pay TV.

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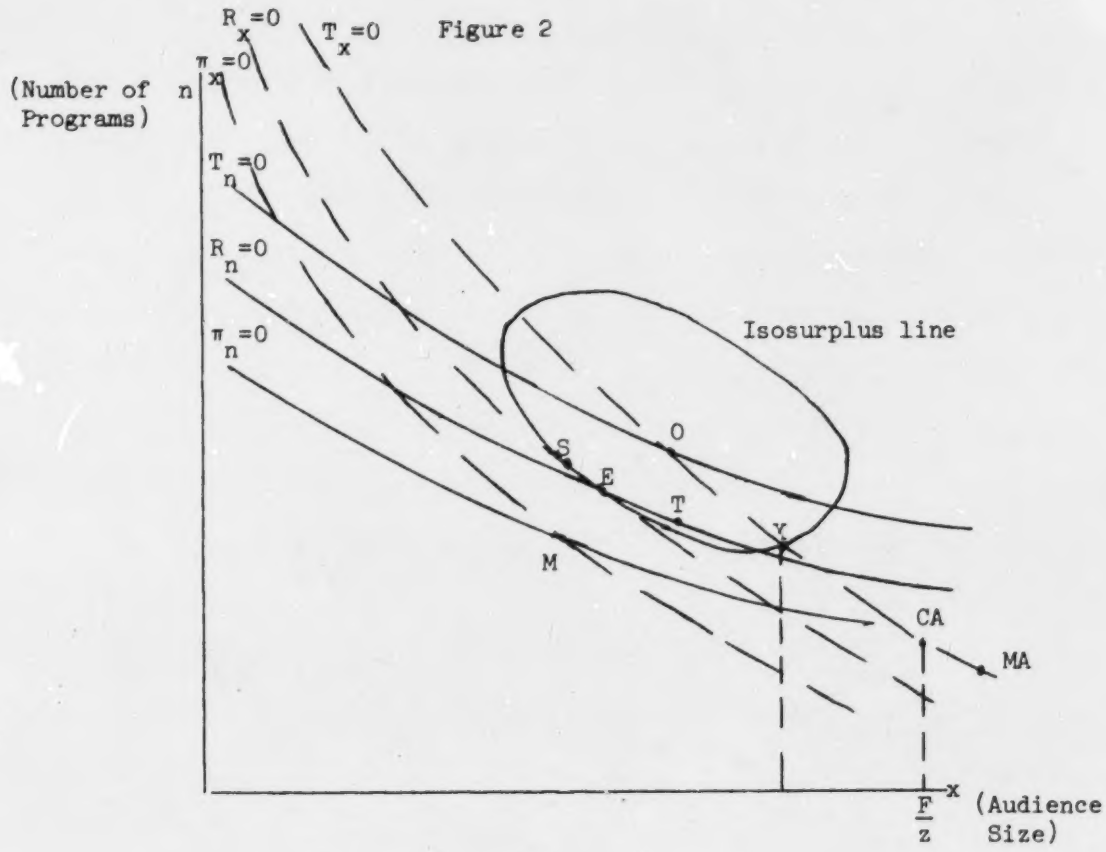


Figure 2

Summary of Points:

O	optimum
E	competitive pay TV equilibrium
M	monopoly pay TV
S	second best optimum given $\pi \geq 0$ constraint
T	second best optimum given monopolistically competitive pricing
CA	competitive advertiser support equilibrium (with unlimited channels)
MA	monopoly advertiser support
X	If advertiser TV were subsidized to permit more programs, the point at which the total surplus is the same as at E.

The Relative Positions of the Equilibria

The relative positions of the various equilibria in Figure 2 obviously depend upon some assumptions about the magnitudes of the parameters in the model. And since these positions determine the attractiveness of the equilibria from a welfare point of view, it is important to discuss how the equilibria move about when the parameters change.

The relationship between E and O is determined largely by the own price elasticity of demand for the representative product. This is most easily seen by observing that the demand for a representative program is

$$p = \phi' - 2A\bar{x}(n - 1) \quad , \tag{32}$$

so that

$$\frac{dp}{dx} = \phi''(x) \quad . \tag{33}$$

Thus if ϕ'' is small, the inverse demand curve is flat. But ϕ is also more nearly linear so that ϕ and $x\phi'$ do not differ greatly. The surplus, T, and the function implicitly maximized under monopolistic competition, R, differ in that ϕ is replaced by $x\phi'$. When this difference is small, the optima, E and O, are close together. Conversely, it is when price elasticities are low that E and O are far apart.

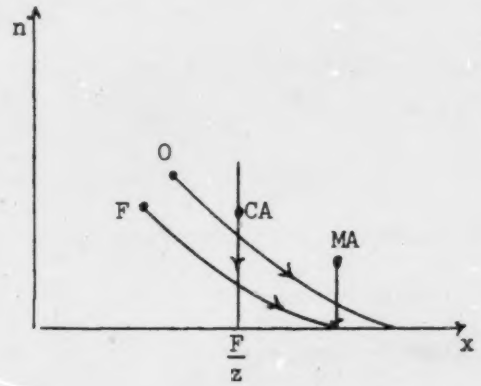
In contrast, the relative positions of CA, the advertiser supported equilibrium, and O, the optimum, are determined by the cross elasticities

of demand, and by the size of z relative to the average valuation of a program by viewers. Cross elasticities or degrees of substitutability are determined by the parameter A. As A increases (programs become closer substitutes), the optimum can be shown to move downward and to the right as depicted in Figure 3.[17] Similarly the equilibrium under pay TV, E, also moves down and to the right. The number of programs declines and the audience size increases. On the other hand, the advertiser supported equilibrium simply moves down. The number of programs is reduced but audience size remains the same. Two conclusions follow immediately. If cross elasticities are high, then competitive advertiser support may be preferable to pay TV. And if cross elasticities are even higher so that the optimum is to the right of the competitive advertiser supported equilibrium, CA, then monopoly under pay TV (MA) may be preferred to competitive advertiser support and pay TV. With very close substitutes, the tendency of monopoly to restrict programs becomes an advantage. This conclusion for the case of perfect substitutes appears in the literature, where it is argued that monopoly avoids duplication of perfect substitutes.[18]

Monopoly has another potential advantage. If the number of channels is limited, competitive advertiser support may use up scarce channels with close substitutes. Monopoly may limit the number of close substitutes, and use the remaining channels for programs that are less perfect substitutes. Such programs may be less profitable individually but do not cut into the audiences generated by the other programs as much.

Figure 3

Effect of Increasing Program Substitutability



The importance of cross elasticities in determining the relative positions of the optimum (O) and the equilibrium (CA) is sufficient to justify a brief analytic treatment. The gross dollar benefits from n programs of audience size x are

$$B = n\phi(x) - Ax^2(n^2 - n) \quad . \tag{34}$$

The rate of increase of these benefits with the number of programs is

$$\frac{\partial B}{\partial n} = \phi - Ax^2(2n - 1) \quad . \tag{35}$$

Thus the rate of increase of benefits per viewer is

$$\frac{1}{x}\frac{\partial B}{\partial n} = \frac{\phi(x)}{x} - Ax(2n - 1) \quad . \tag{36}$$

The rate of increase of costs (nF) per viewer, is clearly

$(1/x)(\partial(nF)/\partial n) = F/x$. Now let us examine those quantities at the competitive advertiser supported equilibrium.

At that equilibrium, the audience size is F/z. In addition, prices are zero so that

$$\phi'(y) = 2Ay(n - 1) \tag{37}$$

where $y = F/z$. This expression defines the equilibrium number of programs, n. Using (37), and substituting in (36), we find that the rate of increase of average benefits per viewer with the number of programs is

$$g = \frac{1}{y}\frac{\partial B}{\partial n} = [\frac{\phi(y)}{y} - \phi'(y)] - Ay \quad . \tag{38}$$

The rate of increase of costs is $F/y = z$.

One can now see precisely what determines the relationship between the optimum and the equilibrium. If g, the average benefits per viewer of the marginal program, exceeds z, the average cost, the number of programs should be increased from the equilibrium and conversely. From (38), one observes that increasing the cross effect, A, makes average benefits smaller. If A is large enough, g may be less than z, that is, the optimum has fewer programs than the equilibrium. The other factor that determines average benefits at the equilibrium is the term in square brackets in (38). It is positive because ϕ is concave. Moreover, speaking somewhat imprecisely, the more concave ϕ is, the steeper the inverse demand and the larger the average benefits <u>of an additional</u> program.[19/]

To assess the performance of the present system, one wants to compare g and z, or equivalently gy and $zy = F$. This can be done for networks rather than programs with the available data. Table 1 presents some rough and ready empirical data on the issue at hand. Using demand estimates for cable TV, Noll, Peck and McGowan [1973] estimated consumer surplus from (free) network-TV channels. (These are presented in the table in 1970 dollars.) 1970 costs for the operation of the three networks and their affiliated stations averaged $800 million per channel. Various authors, including Park [1973], have estimated that the profitability of a fourth advertiser supported network is approximately nil. The figures in the profit column are simply the authors' guess as to normal network profits averaged over the business cycle.

Table 1

Benefits, Costs, and Profits from TV Channels
(millions of dollars per year)

Number of channels	Consumer surplus	Marginal consumer surplus	Marginal cost	Marginal profit (advertising)
1	16000	16000	800	100
2	25100	9100	800	75
3	31300	6200	800	25
4	36000	4700	800	$\simeq 0$
5	39800	3800	800	< 0

Source: Consumer surplus based on estimates in Noll, Peck and McGowan [1973] (p. 288); other data based on rough estimates by the authors: see text.

The point of all this is that while the addition of more networks clearly adds to surplus up to some point far beyond the present number (three), these new networks would not be profitable under advertising support. While the estimates are rough, the orders of magnitude are almost certainly correct. Thus, advertising prices fail by a wide margin to reflect viewers' valuations of programs. This suggests that the competitive, advertiser supported equilibrium (CA in Figure 2) is not in fact very close to the optimum in absolute terms, and increases the likelihood that E is superior to CA.

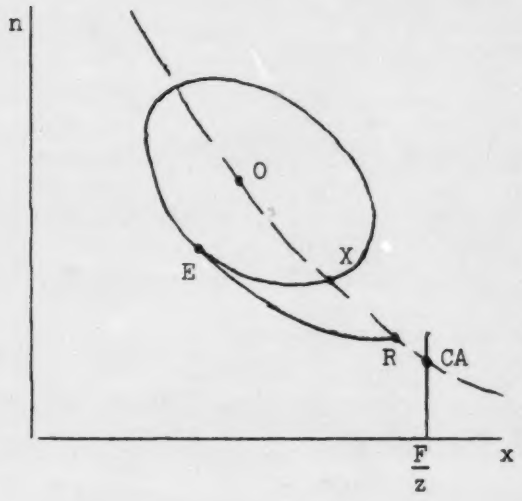
Consumer Surplus

It might be argued that the total surplus is not what one ought to focus on, but rather consumer surplus (the benefits to the public). It is true that some of the benefits of pay TV accrue to the producers of programs. But that does not imply that consumers are hurt, on average. It is of course almost inevitable that a change from advertiser support to cable will redistribute benefits. The consumer surplus in the symmetric case is simply

$$S = T(x,n) - \pi(x,n)$$
$$= n(\phi - x\phi') + Ax^2(n^2 - n) \quad . \tag{39}$$

Iso-consumer surplus lines are tangent both to iso-total surplus lines and to isoprofit lines. The iso-consumer surplus line through E is depicted in Figure 4. It intersects the marginal cost pricing line at R. It is below and to the right of X, where the <u>total</u> surplus is the

Figure 4



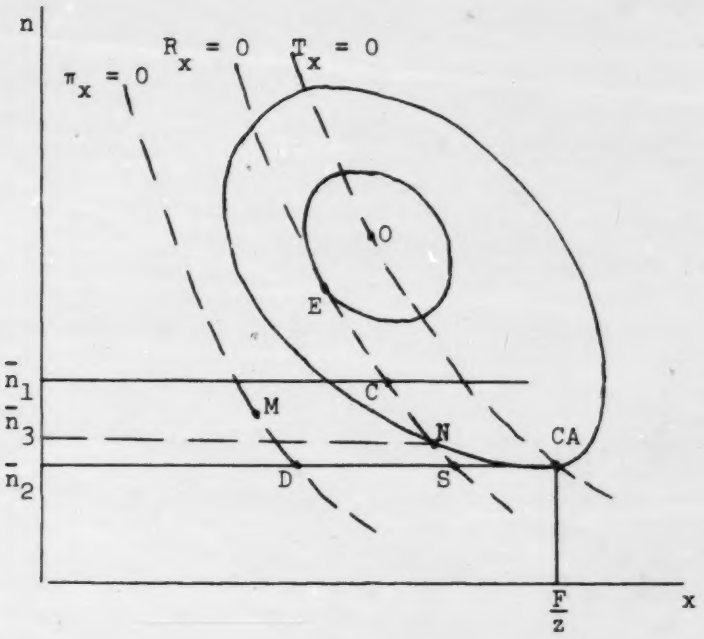
same as at E. It is possible for CA to lie between X and R. In that case pay TV would increase the total surplus but hurt consumers (qua consumers--someone gets the revenues or profits). The position of CA relative to R is an empirical question. For the reasons cited above, we think CA is likely to be considerably to the right of X and R.

Limited Channels

The FCC is alleged to artificially limit available channels, at least on the VHF band in the larger cities, with the result that broadcasters earn scarcity rents and program variety is reduced.

The effect of limiting the number of available channels can be examined with the aid of Figure 5. If the number of channels is restricted to $\bar{n}_1$, competitive pay TV will generate the outcome C. It is

Figure 5



worse than the equilibrium E. The constraint $n \leq \bar{n}_1$ has no effect on a monopolist. If n is constrained to be equal or less than $\bar{n}_2$, the monopolist under pay TV will be at D, and competition under pay TV is at S. And since $\bar{n}_2$ is the number of channels in an advertiser supported equilibrium, S is inferior to CA. In order that pay TV produce a preferred outcome, the channel constraint must be lifted to $\bar{n}_3$. The outcome then becomes N (N and CA are on the same iso-total surplus line).

The two conclusions that follow from these facts are first, that if channel capacity is naturally limited, pay TV may not be desirable, and second, that pay TV has few virtues if entry into the programming industry is effectively restricted by holding the number of channels down. Under

pay TV restrictions on entry serve no purpose beneficial to consumers.[20] In fact, the number of channels is not "naturally" limited, especially in cable. But these results suggest that it may be a mistake for the FCC to allow pay TV in the existing artificially limited over-the-air channels unless steps are taken to allow expansion of channel capacity.

First Best Outcomes and Informational Requirements

If one supposes, for the sake of argument, that suppliers of programs were perfect price discriminators, then it is not difficult to see that the program selection problem would disappear. For if each supplier of a program could perfectly price discriminate, he could appropriate exactly the marginal contribution of his product to the total benefits. Thus with price discrimination, the producer of the i-th program has profits of

$$
\begin{aligned}
(40) \qquad \bar{\pi}_i &= \Delta T_i(x) - F_i \\
&= B(x) - B(x_1,\ldots,x_{i-1},0,x_{i+1},\ldots,x_n) - F_i \\
&= [B(x) - \textstyle\sum_j F_j] - [B(x_1,\ldots,0,\ldots,x_n) - \sum_{j\neq i} F_j] \\
&= \Delta T_i \\
&= T(x) - T(x_1,\ldots,x_{i-1},0,x_{i+1},\ldots,x_n) \quad .
\end{aligned}
$$

When the i-th producer maximizes profits, he is maximizing the total surplus, $T(x)$ with respect to x_i. The equilibrium is optimal, and price discrimination would eliminate the problem.[21]

The optimal policy would be to forbid any marginal fees (such as per program charges) and to supplement the resulting programs with direct subsidies to programs which, while contributing to surplus, did not appear in the private market. This is in fact almost exactly the present policy in a superficial sense: per program charges are in practice forbidden and there are direct subsidies to public broadcasting stations. In fact, however, no attempt is made to subsidize those programs which would make the greatest contribution to surplus. One reason this is not done is that the costs of acquiring the information requisite to the task are enormous. (The government would require the same information needed by the price-discriminator--in effect, the reservation price of each individual for each program, and all the substitution effects.) Even if the information were somehow available, there would be serious First Amendment questions involved in the subsidization policy, since presumably some programs would be controversial. It is for these reasons that we enquire into the probable effects of second-best institutional alternatives, despite the superficial suitablity of present policies.

4. Summary of Results

This paper has focused on the welfare implications of alternative market structures and policies in the broadcasting industry. Welfare is measured by the sum of producers' and consumers' surplus. It has been demonstrated that any of the private market systems considered contain biases against certain kinds of programs. These biases result in the

absence from the market of programs which "ought" to be produced, in the sense that their marginal benefits exceed their marginal costs. The programs which are likely to be omitted are those with low own-price elasticity of demand ("minority taste programs") and those which are expensive to produce. The cause of this bias is the failure of prices, as marginal signals, to reflect fully the average intensity of preferences for certain programs. In the presence of fixed costs, this leads to the nonviability of such programs, since benefits but not revenues exceed costs. The bias is present with pay TV, but it is worse under a competitive, advertiser supported structure such as we now have. This is so because pay TV prices reflect intensity of preferences better than the flat capitation rate paid by advertisers. In the pay TV case, monopoly does worse than competition, unless there is perfect price discrimination. An advertiser supported monopolist produces fewer programs, and has the same biases, as a competitive advertiser supported system.

Leaving aside the question of bias among program types, we can examine the positions of the various market structure equilibria with respect to each other and the optimum in terms of the number of programs produced and their audience sizes. This is done by taking the symmetric case in which all programs have identical demand and cost parameters. The relative positions of the equilibria depend on empirical issues, and in particular on the degree to which programs are close substitutes for each other. As the cross elasticity of substitution among programs increases, advertising support becomes more (and pay TV less) likely to

approximate a feasible second-best structure for the medium. Some sketchy empirical evidence suggests that the advertiser supported equilibrium is in fact not very close to the optimum. Another possible reason for preferring advertiser support is in the case where channels are either naturally or artificially limited. Here, pay TV may well make things worse. Thus, the argument for pay TV does depend on channels being unlimited, or equivalently, on a policy of open entry.

Finally, a first-best solution requires a set of subsidies and rules which are remarkably similar on the surface to those which presently exist. Unfortunately, the information required to operate successfully in this mode is not available. Determination of the second-best policy requires empirical analysis. Casual empiricism suggests that a system of open entry and pay TV is probably the second-best market structure. This has certain policy implications.

Policy Implications

The FCC has been trying to deal with the issues of cable television and pay TV for some years, and the matter is far from being settled. Much of the debate turns on economic harm to one or another segment of the industry, and consequent harm to the customers of those firms hurt by structural change. This is equivalent to a concern for interpersonal transfers, rather than concern for welfare maximization *per se*. (In practice of course the interest groups that debate these questions seldom represent consumer interests.) But supposing that the FCC were in fact interested in maximizing viewer or social welfare,

rather than protecting the profits of existing firms, what policies should it pursue?

Leaving cable television aside, entry into broadcasting is strictly limited by FCC spectrum allocation policy. In these circumstances, a shift from advertiser support to pay TV is very likely to leave viewers worse off, particularly if advertising is forbidden on pay channels. This is so because prices will depart significantly from marginal costs without the potential offsetting benefit of increasing the number of programs offered. The effect would simply be a shift of income from viewers to broadcasters. There may however be some improvement in the bias against low elasticity (minority taste) programs.

Cable television changes the picture, because the supply of channels is not completely inelastic. If cable (which is a natural monopoly in a local area) is structured as a common carrier, so that there is open entry into the business of supplying programs to viewers over the system, then we can have monopolistic competition in the supply of programs. Then, pay TV may very well be the best of the feasible market structures. It is still important, however, not to bar advertising on pay channels, since in the event that our empirical intuition is not correct, advertising will serve as a safety valve on the extraction of consumer surplus from popular programs with close substitutes.

Present FCC policies discourage the growth of cable television and prevent any charges to viewers for most programs; in addition, present

policy is to make the cable television operator a monopolist of content on his channels, rather than a common carrier. These do not seem to be the correct policies.

It must be emphasized that we cannot dispose of the policy issues because we do not have definitive evidence on the crucial empirical questions. The present analysis provides a framework for the application of empirical evidence, and intuition. Our own intuition suggests that the best of the feasible policies is to create a system of open entry with an elastic supply of channels (common carrier cable television systems), and to allow program suppliers to charge both advertisers and viewers for the programs. This will not maximize welfare, but it seems likely to come closer than any of the feasible alternatives. Such a system can be supplemented with subsidies to programs which are still inefficiently omitted from the market, as with public broadcasting, to the extent this is consistent with the First Amendment. In any event, it is far from clear that the present policy of protecting the monopoly profits of broadcasters in the name of viewer protection is correct.

We can relate this analysis to the terms of the actual policy debate about pay TV. Industry proponents of pay TV (mainly the Hollywood studios) have argued that pay TV will result in more special-interest programs, and to the extent that channel capacity is elastic, more programs generally. Opponents (mainly broadcasters) have argued that viewers will simply be paying for what they now get free; that programs will not really be different, and, to the extent pay TV competes with free TV, popular programs

will be "siphoned" away from free TV. It is true that pay TV programs will, in equilibrium, be different from advertiser supported programs, and that the nature of the difference lies in a reduction of the bias against minority taste programs. But it is not necessarily the case that the first pay TV programs (that is, the most profitable ones) will be much different. Thus, siphoning may indeed occur, and with limited channels, that is about all that would occur. But pay TV on cable, with its elastic supply of channels, offers the opportunity for more programs than can be supported by advertising, and this has a desirable effect on viewer welfare, quite aside from the reduction in bias.

Appendix: Analysis of the Symmetric Case

The total surplus can be written as follows

$$T(x,n) = n\phi(x) - Ax^2(n^2 - n) - nF \tag{43}$$

from (4) with $\phi_i \equiv \phi$, $F_i = F$ and $A_{ij} = A$ for all i and j. The two optimizing conditions are $T_x = 0$ or,

$$\phi' = 2Ax(n - 1) \quad , \tag{44}$$

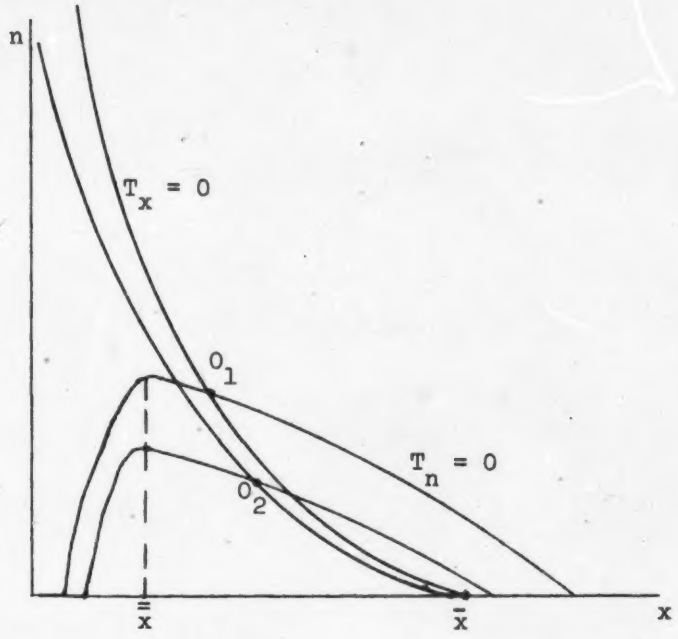
and $T_n = 0$ or,

$$n = \frac{1}{2} + \frac{\phi - F}{2Ax^2} \quad . \tag{45}$$

Figure 6 shows a picture of these two conditions. Note that when $n = 1$, $\phi'(x) = 0$. Let that occur at $x = \bar{x}$. Note also that the pick of the curve $T_n = 0$ occurs when $(\phi - F)/x^2$ is at a maximum. Let that quantity be $\bar{\bar{x}}$. The optimum is at 0_1. Now suppose we raise A. Both curves drop downward (see (44) and (45)). However, the line $T_x = 0$ pivots around $(\bar{x},1)$, because, for every A, $\phi'(x) = 0$ when $n = 1$. Therefore, as A rises, the optimum must eventually approach the point $(\bar{x},1)$, because, eventually the line $T_n = 0$ will hit the x-axis to the left of $\bar{x}$. This means that as the cross elasticities become high, the optimal number of programs falls and the optimal audience size rises toward $\bar{x}$.

To analyze the equilibrium with pay TV, we simply replace ϕ by $\mu(x) = x\phi' < \phi$ in the preceding equations. The equivalent of $\bar{x}$ occurs

Figure 6



when $\phi' + x\phi'' = 0$. Let that point by $\hat{x}$. Clearly $\hat{x} < \bar{x}$. Similarly the analogue of $\hat{\hat{x}}$ occurs at the maximum of $x\phi'/x^2$. Call that point $\hat{\hat{x}}$. Again $\hat{\hat{x}} < \hat{\hat{x}}$.

The fact that $\hat{x} < \bar{x}$ is of special importance. It says that as cross elasticities become large, and the programs become more perfect substitutes, the equilibrium and the optimum do not approach each other. The reason is that high cross elasticities keep the number of profitable programs down. It is for this reason that advertiser supported TV may be preferable for a group of close substitutes. It is also why forbidding advertising on pay TV is a risky strategy.

The difference between the equilibrium and the optimum is determined by the difference between ϕ and $x\phi'$. If ϕ is close to being linear,

own price elasticity is high and ϕ and $x\phi'$ are close in value. The optimum and the equilibrium would not then be far apart. If ϕ is sharply concave, own price elasticity is low; ϕ and $x\phi'$ differ considerably and the equilibrium is further from the optimum.

Footnotes

1/ The major papers are those of Steiner [1954], Rothenberg [1962], and Wiles [1963]. For a critical survey of this literature, see Chapter 3 of Owen, Beebe and Manning [1974]. The traditional approach is to measure welfare by seeing which policy produces the largest audience, or the most "first choices" in viewers' rank orderings of the programs. This ignores intensity of preferences.

2/ The scarcity argument is ambiguous. There are probably too few VHF stations in the larger cities, given the FCC policies with respect to geographical distribution of stations. On the other hand, a fourth network might not be viable (see Park [1973]), and some UHF licenses go begging. Thus, given advertiser support and other FCC policies, the number of channels in many areas may not be far from its free entry equilibrium. None of the foregoing should be confused with the (erroneous) argument that the electromagnetic spectrum as a whole is "intrinsically" characterized by a scarcity transcending that of other resources. (See Greenberg [1969], Levin [1971].)

3/ Cable television is simply television by wire. The wire makes it easier to exclude and bill people who consume the product. Also, the wire's capacity is not constrained (yet) by FCC policies: it has "unlimited" channels.

4/ E. g., Steiner [1954].

5/ Willig [1973] has shown that even when income effects are present, the percentage errors involved in taking areas under Marshallian demand curves may not be too large.

6/ Spence [1974] contains a fuller treatment of the problem.

7/ The results we derive using this functional form hold in a more general setting. The general forces at work in product selection under monopolistic competition are discussed in Spence [1974]. Here, competition under pay TV will correspond to monopolistic competition. The benefit function, $B(x)$, is the multi-market surplus gross of costs. It can be written (in terms of inverse demand functions),

$$B(x) = \sum_{i=1}^{n} \int_{0}^{x_i} p_i(x_1,\ldots,x_{i-1},s_i,0,\ldots,0)ds_i \quad ,$$

the form that most economists are used to.

8/ This amounts to assuming that the demand for advertising is highly elastic above the market price.

9/ Thus we assume the game is played in quantities and the equilibrium is the Nash equilibrium. Price competition would generate somewhat different equilibria, but the qualitative properties would be the same. If the conjectural variation is to hold quantity constant, then firms anticipate price cuts in response to their own price cuts. This does not seem an entirely unreasonable assumption.

10/ Since $\pi_i = a_i x_i^{\beta_i} - c_i x_i - F_i$, it is maximized with respect to x_i when $\partial\pi_i/\partial x_i = a_i\beta_i^2 x_i^{\beta_i - 1} - c_i = 0$, or $x_i = (a_i\beta_i^2/c_i)^{1/1-\beta_i}$. At that point, $\pi_i^* = c_i((1/\beta_i) - 1)(a_i\beta_i^2/c_i)^{1/1-\beta_i} - F_i$. Similarly $\Delta T_i = a_i x_i^{\beta_i} - c_i x_i - F_i$ is maximized with respect to x_i when $x_i = (a_i\beta_i/c_i)^{1/1-\beta_i}$. At that point $\Delta T_i^* = c_i((1/\beta_i) - 1)(a_i\beta_i/c_i)^{1/1-\beta_i} - F_i$. Thus comparing π_i^* and ΔT_i^*, we have

$$\pi_i^* + F_i = \beta_i^{\frac{1}{1-\beta_i}}(\Delta T_i^* + F_i)$$

as asserted.

11/ Let $n(\beta) = \beta^{1/1-\beta}$. When $\beta = 0$, $n(\beta) = 0$, and when $\beta = 1$, $n(\beta) = 1$. Moreover, $\log n(\beta) = (1 - \beta)\log\beta \leq 0$, so that $0 \leq n(\beta) \leq 1$ for all β. Taking logs and differentiating we have $n'(\beta)/n(\beta) = (1/\beta) - 1 - \log\beta > 0$, so that $n(\beta)$ is monotonically increasing on the interval $[0,1]$.

12/ Monopoly, in addition to having the biases just described for competitive advertiser support, also tends to restrict the number of programs. It does this because the profits of a new program are greater than its contribution to industry profits, due to the substitution effect. An extreme special case of this tendency is referred to as common denominator programs in the literature (see Rothenberg [1962]). There is a collection of programs among which there are no substitution effects. Then there is a program that interacts with each of the others. In terms of the matrix of cross partials, the

pattern is the following,

$$A = \left(\begin{array}{c|c} & A_{1n} \\ 0 & A_{2n} \\ & \vdots \\ & A_{n-1,n} \\ \hline A_{n1},\ldots,A_{n,n-1} & 0 \end{array}\right)$$

The n-th program is a common denominator (LCD). Suppose the common denominator is supplied and that the remaining programs are profitable even so. Competition would introduce the remaining programs and possibly drive the LCD out. The monopolist, however, may not introduce the non-LCD's because the net effect on profits is negative. This is usually thought to be bad for welfare. But the conclusion is unwarranted without further assumptions (see the section on numbers of programs).

It is, however, true that monopoly under advertiser support is more sparing in its supply of programs. And if there are two few programs under competition, monopoly will be less desirable. The evidence cited later seems to us to indicate that competition with advertiser support generates too few programs. In any case, LCD's are simply a special case of the monopoly tendency to restrict programs relative to competition with advertiser support.

13/ For the linear case, $p_i = a_i - 2A_{ii}x_i - c_i$. At the optimum, $p_i = 0$, or $x_i = (a_i - c_i)/2A_{ii}$. The contribution to surplus is $\Delta T_i = (a_i - c_i)x_i - A_{ii}x_i^2$. At the optimum, $p_i = 0$, and

$$\Delta T_i^* = \frac{1}{4}\frac{(a_i - c_i)^2}{A_{ii}} \quad .$$

Profits are $p_i x_i - F_i = (a_i - c_i)x_i - 2A_{ii}x_i^2 - F_i$. They are maximized when $x_i = (a_i - c_i)/4A_{ii}$. At that point

$$\pi_i^* = \frac{1}{8}\frac{(a_i - c_i)^2}{A_{ii}} \quad ,$$

as asserted.

14/ The price system can be thought of as a voting system of the following type. A program is accepted if a group can be found that will vote for it (provided every member of the group pays the same fee) and such that the fee times the size of the group covers the costs. What one wants of course, is to allow members of the group to pay different amounts. This amounts to price discrimination which is the requirement for any voting scheme to generate the efficient amount of a public good (see Demsetz [1974], Oakland [1974], and Thompson [1968] on public good aspects of TV).

15/ The optimum in fact occurs when for each i, $\partial T/\partial x_i = \phi_i' - 2\sum_j A_{ij}x_j + z$ $= p_i + z = 0$. Thus at the optimum $p_i = -z$, for all i. However, even if TV were subsidized, negative prices might be infeasible because people could leave their television sets on (without watching) to earn money. Thus, in what follows, the optimum is approximated by $p_i = 0$ $i = 1,\ldots,n$, which is the pattern of pricing under advertiser supported TV.

16/ The reason is that at S, an iso-total surplus line is tangent to the line $R_x = 0$. At T, an iso-total surplus line is tangent to $R_n = 0$. If S and T coincided at E, the isosurplus line through E would be tangent to two lines that cross, which is impossible.

17/ This is argued in the appendix.

18/ See Steiner [1954].

19/ This can be stated more precisely. Suppose that $\phi(x) = dx^{\beta}$. It follows that average benefits are

$$a = d(1 - \beta)y^{\beta-1} - Ay \quad .$$

This function increases with d, decreases with A, and decreases with y. The derivative with respect to β is

$$\frac{da}{d\beta} = y^{\beta-1}[d(1 - \beta)\log(y) - 1] \quad .$$

It has an ambiguous sign. However, if β is near 1 it is negative and if β is small, it is positive.

20/ It is conceivable that the equilibrium, E, under pay TV, has more programs than the optimum constrained to nonnegative profits. That would provide a rationale for restricting channels under pay TV. But the information required to determine that such a restriction would be desirable is unlikely to be available.

21/ It is a general theorem that perfect price discrimination under monopolistic competition eliminates the product choice problem (see Spence [1974]). A special case is monopoly: there profits and the total surplus are the same.

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